What is Claimed is:

1. A process for monitoring the gaseous environment in a crystal pulling furnace, used for the growth of an ingot of semiconductor material in a growth chamber maintained at a sub-atmospheric pressure, the process comprising:

sealing the growth chamber;

reducing the pressure within the sealed chamber to a sub-atmospheric level;

introducing a process gas into the chamber to purge the chamber and form a gaseous environment within the chamber; and,

analyzing the gaseous environment for a contaminant gas in a concentration in excess of the concentration of said gas in the process gas.

2. A process as set forth in claim 1 wherein the contaminant gas is selected from the group consisting of nitrogen, oxygen, carbon monoxide and water vapor.

3. A process as set forth in claim 1 wherein the concentration of the contaminant gas for which analysis is performed is reported in real time.

4. A process as set forth in claim 1 wherein a residual gas mass analyzer or a gas chromatograph is used to analyze the gaseous environment.

5. A process as set forth in claim 1 wherein the ingot has a nominal diameter of at least about 150 mm, 200 mm, 300 mm or more.

6. A process as set forth claim 1 wherein the ingot has a carbon concentration of less than about 5×10^{16} atoms/cm^3, 1×10^{16} atoms/cm^3, or even 5×10^{15} atoms/cm^3.

7. A process as set forth in claim 1 wherein a mass of molten semiconductor material is formed in the growth chamber, the analysis being performed prior to the formation of the molten mass.

8. A process as set forth in claim 7 wherein the gaseous environment is analyzed to determine if the concentration of nitrogen is less than about 600 ppmv, 400 ppmv, 200 ppmv or 100 ppmv, prior to formation of the molten mass.

9. A process as set forth in claim 8 wherein the gaseous environment is analyzed about once every 20 minutes, 15 minutes, 10 minutes, 5 minutes, 1 minute or less.

10. A process as set forth in claim 8 wherein the gaseous environment is continuously analyzed.

11. A process as set forth in claim 8 wherein the gaseous environment is analyzed by collecting a sample of a gaseous atmosphere above or adjacent to a melt surface of the molten mass formed in the growth chamber.

12. A process as set forth in claim 8 wherein the gaseous environment is analyzed by collecting a sample of an exhaust gas from the sealed growth chamber.

13. A process as set forth in claim 7 wherein the gaseous environment is analyzed to determine if the concentration of oxygen is less than about 100 ppmv, 90 ppmv, 60 ppmv, or 30 ppmv, prior to the formation of the molten mass.

14. A process as set forth in claim 13 wherein the gaseous environment is analyzed about once every 20 minutes, 15 minutes, 10 minutes, 5 minutes, 1 minute or less.

15. A process as set forth in claim 13 wherein the gaseous environment is continuously analyzed.

16. A process as set forth in claim 13 wherein the gaseous environment is analyzed by collecting a sample of a gaseous atmosphere above or adjacent to a melt surface of the molten mass formed in the growth chamber.

17. A process as set forth in claim 13 wherein the gaseous environment is analyzed by collecting a sample of an exhaust gas from the sealed growth chamber.

18. A process as set forth in claim 7 wherein the gaseous environment is analyzed to determine if the concentration of water vapor is less than about 1000 ppmv, 800 ppmv, 400 ppmv, or 200 ppmv, prior to the formation of the molten mass.

19. A process as set forth in claim 18 wherein the gaseous environment is analyzed about once every 20 minutes, 15 minutes, 10 minutes, 5 minutes, 1 minute or less.

20. A process as set forth in claim 18 wherein the gaseous environment is continuously analyzed.

21. A process as set forth in claim 18 wherein the gaseous environment is analyzed by collecting a sample of a gaseous atmosphere above or adjacent to a melt surface of the molten mass formed in the growth chamber.

22. A process as set forth in claim 18 wherein the gaseous environment is analyzed by collecting a sample of an exhaust gas from the sealed growth chamber.

23. A process as set forth in claim 7 wherein a mass of molten semiconductor material is formed and an ingot is

grown from the molten mass formed in the growth chamber, the analysis being performed during ingot growth.

24. A process as set forth in claim 23 wherein the gaseous environment is analyzed by collecting a sample of a gaseous atmosphere above or adjacent to a melt surface of the molten mass formed in the growth chamber.

25. A process as set forth in claim 24 wherein the gaseous environment is analyzed to determine if the concentration of nitrogen is less than about 600 ppmv, 400 ppmv, 200 ppmv or 100 ppmv.

26. A process as set forth in claim 24 wherein the gaseous environment is analyzed to determine if the concentration of oxygen is less than about 100 ppmv, 90 ppmv, 60 ppmv, or 30 ppmv.

27. A process as set forth in claim 24 wherein the gaseous environment is analyzed to determine if the concentration of water vapor is less than about 1000 ppmv, 800 ppmv, 400 ppmv, or 200 ppmv.

28. A process as set forth in claim 24 wherein the gaseous environment is analyzed to determine if the concentration of carbon monoxide is less than about 30 ppmv, 20 ppmv, 10 ppmv or 5 ppmv.

29. A process as set forth in claim 24 wherein the gaseous environment is analyzed about once every 20 minutes, 15 minutes, 10 minutes, 5 minutes, 1 minute or less.

30. A process as set forth in claim 24 wherein the gaseous environment is continuously analyzed.

31. A process as set forth in claim 24 wherein the concentration of the contaminant gas for which analysis is performed is reported in real time.

32. A process as set forth in claim 24 wherein a residual gas mass analyzer or a gas chromatograph is used to analyze the gaseous environment.

33. A process as set forth in claim 24 wherein the ingot has a nominal diameter of at least about 150 mm, 200 mm, 300 mm or more.

34. A process as set forth claim 24 wherein the ingot has a carbon concentration of less than about 5×10^{16} atoms/cm^3, 1×10^{16} atoms/cm^3, or even 5×10^{15} atoms/cm^3.

35. A process as set forth in claim 23 wherein the gaseous environment is analyzed by collecting a sample of an exhaust gas from the sealed growth chamber.

36. A process as set forth in claim 35 wherein the gaseous environment is analyzed to determine if the concentration of nitrogen is less than about 600 ppmv, 400 ppmv, 200 ppmv or 100 ppmv.

37. A process as set forth in claim 35 wherein the gaseous environment is analyzed to determine if the concentration of oxygen is less than about 100 ppmv, 90 ppmv, 60 ppmv, or 30 ppmv.

38. A process as set forth in claim 35 wherein the gaseous environment is analyzed to determine if the concentration of water vapor is less than about 1000 ppmv, 800 ppmv, 400 ppmv, or 200 ppmv.

39. A process as set forth in claim 35 wherein the gaseous environment is analyzed to determine if the concentration of carbon monoxide is less than about 100 ppmv, 80 ppmv, 60 ppmv, 40 ppmv, or 20 ppmv.

40. A process as set forth in claim 35 wherein the gaseous environment is analyzed about once every 20 minutes, 15 minutes, 10 minutes, 5 minutes, 1 minute or less.

41. A process as set forth in claim 35 wherein the gaseous environment is continuously analyzed.

42. A process as set forth in claim 35 wherein the concentration of the contaminant gas for which analysis is performed is reported in real time.

43. A process as set forth in claim 35 wherein a residual gas mass analyzer or a gas chromatograph is used to analyze the gaseous environment.

44. A process as set forth in claim 35 wherein the ingot has a nominal diameter of at least about 150 mm, 200 mm, 300 mm or more.

45. A process as set forth claim 35 wherein the ingot has a carbon concentration of less than about 5×10^{16} atoms/cm^3, 1×10^{16} atoms/cm^3, or even 5×10^{15} atoms/cm^3.

46. A process as set forth in claim 23 wherein the analysis is performed during one or more of the following steps in the growth process: formation of a molten mass, growth of a neck portion of an ingot, growth of a seed-cone of an ingot, growth of about 20%, 40%, 60%, 80% or about all of a main body of an ingot, and growth of an end-cone of an ingot.

47. A process as set forth in claim 23 wherein the analysis is initiated when growth of the main body of the ingot begins, and wherein the analysis continues until growth of an end-cone begins.

48. A process as set forth in claim 23 wherein the analysis is performed during growth of about the first half of the main body of said ingot.

49. A process as set forth in claim 23 wherein the analysis is performed during growth of about the second half of the main body of said ingot.

50. A process as set forth in claim 23 wherein the analysis is initiated when the silicon molten melt begins to form, and wherein the analysis continues until cooling of the growth chamber begins.

51. A system for use in combination with an apparatus for growing a semiconductor ingot, said semiconductor growing apparatus having a growth chamber which is maintained at a sub-atmospheric pressure and which contains a gaseous environment comprising a process purge gas, said system comprising:

a port for withdrawing a sample of the gaseous environment from the growth chamber;

a detector for analyzing the sample for a contaminant gas in a concentration in excess of the concentration of said gas in the process purge gas and generating a signal representative of the detected concentration of the contaminant gas, said detector receiving the sample from the growth chamber via a conduit connected to the port; and,

a control circuit receiving and responsive to the signal generated by the detector for determining if the detected concentration of the contaminant gas exceeds a pre-set threshold concentration for said contaminant gas, said

control circuit controlling the semiconductor growth apparatus in response to the determination.

52. The system of claim 51 further comprising an alarm responsive to said control circuit for indicating if the detected concentration of the contaminant gas is in excess of the threshold concentration.

53. A process for use in combination with an apparatus for growing a semiconductor ingot, said growing apparatus having a growth chamber which is maintained at a sub-atmospheric pressure and which contains a gaseous environment comprising a process purge gas, the process comprising:

transferring a sample of the gaseous environment from the growth chamber via a conduit to a detector for analyzing said sample;

analyzing said sample to determine if a contaminant gas is present in a concentration in excess of the concentration of said contaminant gas in the process gas;

determining at least one parameter representative of a condition of the growth process based on the determination of whether the contaminant gas concentration in the sample exceeds the concentration in the process gas; and,

controlling the semiconductor growing apparatus in response to the determined parameter.